What is life-cycle cost analysis?

Life-Cycle Cost Analysis (LCCA) is an analytical technique that is built on well-founded economic principles to evaluate long-term alternative investment options. The analysis enables the total cost comparison of competing pavement design alternatives (new or rehabilitation), each of which would be appropriate for implementation to the roadway being considered. By taking into account all of the related costs; agency and user cost, that would occur throughout the life of each alternative, this analytical procedure helps to identify the lowest cost alternative to carry out the project and provides other critical information vital for the overall decision-making process. Therefore, LCCA is a tool that can help pavement engineers determine the best way in which to use the taxpayers' money.

Why LCCA & what can you achieve with it?

We are being held accountable for taxpayers' money. In the face of increasing public scrutiny, transportation agency officials as stewards of the transportation network are under great obligation to optimize taxpayer investments in transportation infrastructure. The Federal Highway Administration (FHWA) encourages the use of LCCA in analyzing major investment decisions. The Caltrans Highway Design Manual (HDM) Topics 612 and 619 identify situations where LCCA is needed to assist in determining the most appropriate and most cost-effective alternative for a project by comparing the life-cycle costs of:

- Different pavement types (e.g., flexible, rigid, or composite);
- Different rehabilitation strategies;
- Different pavement design lives (e.g., five-year vs. ten-year, ten-year vs. twenty-year, twenty-year vs. forty-year, etc.); and
- Different construction strategies (e.g., combining widening and rehabilitation projects vs. building them separately).

To illustrate the ability of LCCA to answer questions that could not be answered without such a tool, consider the following simple example in which the performance curve of an existing flexible pavement is shown in Figure 1. The question that the pavement engineers would like to answer is something like whether doing TWO 20-year rehabilitation RAC-G overlays, represented by the blue line, would be more cost-effective (i.e., lower life-cycle cost) than doing FOUR 10-year HMA overlays represented by the red lines. This is noting that the initial cost of a 20-year rehabilitation strategy is usually higher than that of a 10-year strategy, however, with two fewer construction interruptions to highway users.

How does LCCA work?

LCCA should be conducted as early as possible in the project development process. The level of analysis detail should be consistent with the level of investment. The steps needed to perform LCCA are: 1) Establish alternatives; 2) Determine analysis periods; 3) Determine discount rate; 4) Determine maintenance and rehabilitation frequencies; 5) Estimate costs; 6) Calculate life-cycle costs; and 7) Analyze and compare alternatives. The Caltrans LCCA Procedures Manual explains in detail these various steps and provides all the required information and data to run a detailed analysis. The Manual can be found on the Pavement website.

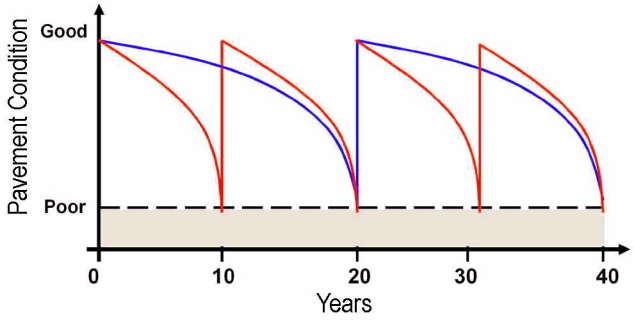


Figure 1: Rehabilitation Schedule

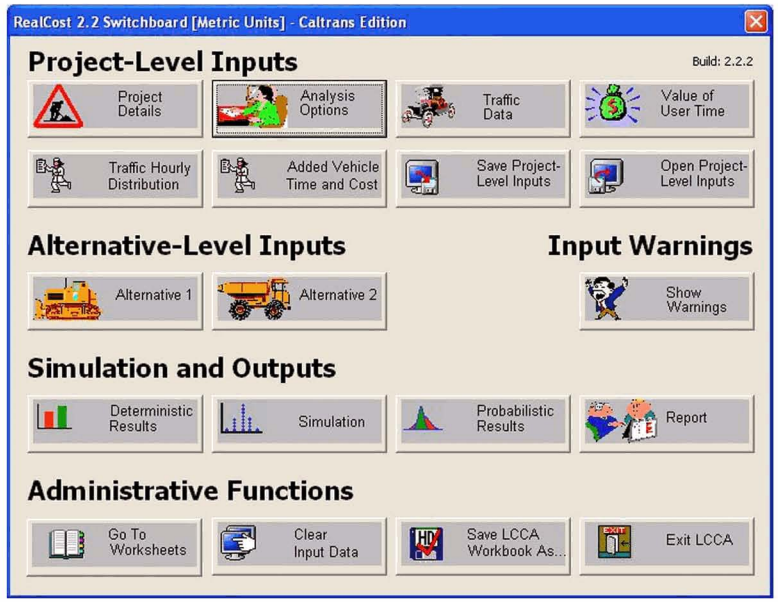


Figure 2: LCCA Input/Output Switchboard

Total Cost	Alternative 1: HMA Overlay 10 years		Alternative 2: RAC-G 20 years	
	Agency Cost ($1000)	User Cost ($1000)	Agency Cost ($1000)	User Cost ($1000)
Undiscounted Sum	*$37,868.91*	*$1,529.20*	*$21,556.75*	*$716.04*
Present Value	**$23,087.66**	**$877.93**	**$15,664.05**	**$496.80**
EUAC	$1,66.47	$44.36	$791.40	$25.10

Lowest Present Value Agency Cost	**Alternative 2: RAC-G 20 year**
Lowest Present Value User Cost	**Alternative 2: RAC-G 20 year**

Figure 3: LCCA Results

When does Caltrans require use of LCCA?

LCCA must be completed for any pavement construction project except for the following:

o Pavement Preservation
o Minor A/B
o Safety and bridge rehabilitation/replacement with cost less than $500,000.
o Projects using Permit Engineering Evaluation Reports
o Maintenance digouts, and
o Landscape paving

The District can still, on a case-by-case basis, decide to perform an LCCA for the excluded projects listed above.

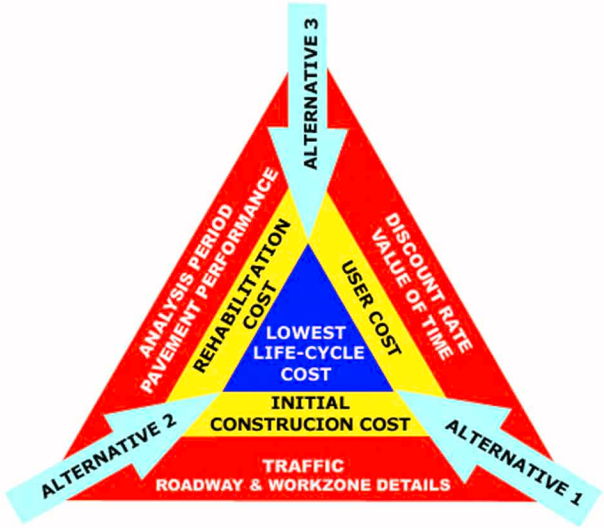
Are there any tools for performing LCCA?

Caltrans has adopted an FHWA supported LCCA software called *RealCost* . The LCCA software runs in Microsoft® Excel 2000®or newer and has an easy-to-navigate graphical user interface, as demonstrated in Figure 2. It produces both text and graphic outputs that can be exported for presentations. One of the software outputs comparing costs of the example presented above is shown in Figure 3, demonstrating a saving of about $7.8 million by doing two RAC-G overlays. *RealCost* can be obtained free directly from Caltrans Pavement website at :

http://www.dot.ca.gov/hq/esc/Translab/OPD/DivisionofDesign-Pavement-Program.htm

Because life-cycle cost analysis is a new practice in Caltrans, the Office of Pavement Design has developed a LCCA Procedures Manual for helping pavement engineers analyze their projects with the aid of this software. The Manual can also be obtained at the Caltrans Pavement website shown above.

Training materials on LCCA can also be obtained at this website. Visit this website for upcoming training courses on LCCA.



For more information on this subject, visit our website at:

http://www.dot.ca.gov/hq/esc/Translab/OPD/DivisionofDesign-Pavement-Program.htm

or contact Mario Velado

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Life Cycle Cost Analysis

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